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WATER QUALITY AND QUANTITY SURVEY OF ALGONQUIN ROAD AREA

CITY OF SUDBURY

1978

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SUMMARY

During the summer of 1978, the Municipal and Private Abatement Section of the Northeastern Region completed an intensive resurvey of Areas B & C situated along Algonquin Road. The resurvey was requested by the Regional Municipality of Sudbury because of the nitrate concentrations and bacteriological counts noted during the McFarlane Lake - Richard Lake Survey of 1975.*

In order to pinpoint problem areas, Areas B and C were subdivided into 6 subareas as noted in Appendix A.

During the survey, 217 homes were visited (76%) and 215 bacteriological and chemical drinking water samples were collected and analyzed. Stream and ditch samples were also collected for laboratory examination.

Septic tanks and tile fields were used by 98% of the residences for sewage disposal. Eleven systems with existing or potential malfunctions were located during the property inspections.

Forty-one premises were discharging laundry wastes directly to ditches contrary to the Environmental Protection Act, 1971.

Dug wells supplied 33% of the homes with potable water and drilled wells supplied 54%. Dug wells were more common in Area 2 and least common in Area 1 where drilled wells were

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* Water Quality and Quantity Survey, McFarlane Lake and Richard Lake Area, City of Sudbury, January, 1976.

numerous (80%). Point sources were used in Areas 1, 3, 5 and 6 to a small degree.

Major water quality complaints voiced by the residents concerned hardness, taste, odour, iron and colour.

Quantity problems were reported in 19% of the homes ranging from a high of 31% of the residences in Area 2 to a low of 7% in Area 4.

Bacteriological examination of the 215 private water supplies revealed very slight bacterial contamination.

Nitrates were noted in Areas 4 and 5 but were not considered a problem in Areas 1, 2, 3 and 6.

Overall aquifer water quality was poor with respect to Ministry desirable criteria, but with the exception of Areas 4 and 5, no serious health hazards existed.

Surface water quality reflected the direct discharge of grey water from several houses and quality would improve with rectification of these illegal discharges.

INTRODUCTION

In 1975 the Municipal and Private Abatement Section of the Northeastern Region completed a survey of the McFarlane and Richard Lake Areas and reported its findings as requested by the Council of the Regional Municipality of Sudbury. Overall, groundwater and surface water quality was not indicative of health and environmental problems except for the localized areas making up the western portion of the survey which were labelled Areas B and C (Appendix A).

The Regional Engineering Committee requested an extensive resurvey of B-C (Resolution 77-10) after investigating the feasibility of connecting the areas to existing City of Sudbury sewer and water services.

The purpose of the 1978 survey was to assess the need for services and provide the area with a rating in order to establish the amount of funding which would be provided by the Province.

From June 19 to July 10, 1978, 217 of the 285 (76%) residences were surveyed in Areas B and C. The population of the area is approximately 1150.

Location and Study Limits

The study area is entirely located in the southern portion of the City of Sudbury in the former Broder Township (Lots 4 and 5, Concession V and VI). It encompasses the residential subdivisions located along Algonquin Road, some light industrial developments and one elementary school located on Algonquin Road.

The following table lists the streets on which residences were surveyed. In order to allow comparisons and to pinpoint problems by areas, six subareas were created within the former Area B-C to facilitate the investigations (Appendix A).

Area	Street Description
1	Muriel Crescent, Louisa Drive.
2	Green Avenue, Part of Algonquin Road.
3	Field and Culver Streets, part of Algonquin Road, Gravelle and Access Streets.
4	Maurice Street and part of Algonquin Road.
5	Rockwood Drive, Greenvalley Drive, Joseph and Fred Streets.
6	Colby and Code Streets, Blyth Drive, Public Road and part of Algonquin Road.

Physiography and Topography

Area B-C lies entirely on the igneous rock of the Canadian Shield. Due to erosion and glacial activity, the rock out croppings are bare and polished while depressions are filled with glacial drift.

A large swamp exists along the western boundary of the study area and smaller wetlands are scattered throughout, indicating poor surface and subsurface drainage.

Surface drainage follows a small stream along Algonquin Road from west to east, which eventually empties into McFarlane Lake.

Area 1 is flat and contains clay with some gravel in its southern portion. Areas 2 and 3 contain clay and rock outcroppings although they are relatively flat. Area 4 has a pronounced slope along Maurice Street and its soil type is predominantly clay with sand occurring in the western portion. Areas 5 and 6 are gently sloped towards Public and Algonquin Roads and contain clay with rock outcroppings. Some sand is reported to occur in Area 5.

Generally, the presence of swampy depressions, clay and rock outcroppings prevent proper drainage throughout the area.

SURVEY PROCEDURES

A survey form was completed at each residence by interviewing the tenant or owner. Appendix B is a sample of the form. The lot was mapped to show the location of the well and sewage disposal system. During the mapping checks for sewage system malfunctions or direct discharges were undertaken.

A bacteriological and chemical drinking water sample was collected at each residence. Bacteriological samples were forwarded to the Sudbury Ministry of Health Laboratory for coliform examination. Chemical samples were shipped to the M.O.E. Thunder Bay Laboratory and analyzed for colour, turbidity, iron, alkalinity, hardness, chloride, sulphate, pH, nitrate, sodium, manganese and conductivity.

Surface water bacteriological samples were collected during the survey at various locations to assess if sewage was gaining access to ditches and the stream.

During the survey, hot weather conditions existed and precipitation was minimal, causing ditches to be mainly dry. With the exception of the stream, no surface water was flowing.

QUESTIONNAIRE RESULTS

Sewage Disposal

Appendix C summarizes the types and ages of the sewage disposal systems reported by the owners and tenants.

Of the 217 systems inspected, 212 (98%) were septic tanks and tile fields, 2 each were pit privies and holding tanks, and one was a Class 6 (Aquarobic) sewage treatment system.

System ages ranged from one month to greater than 15 years. The majority of the systems were greater than 10 years of age (63%). The ages of seventeen systems (8%) could not be determined.

Lot inspections and interviews revealed 11 (5%) systems with existing or potential problems. Only three systems were observed to be malfunctioning at the time of inspection. Two of these had broken tiles allowing sewage to discharge to the surface and the third system was being replaced.

Forty-one residences directly discharged laundry wastes (grey water) to ditches, which is in contravention of The Environmental Protection Act, 1971 (see Appendix C).

Water Supplies

All 217 residences took water from wells, of which 118 were drilled (54%), 71 dug (33%), 24 (11%) were point type wells, and the type of well in 3 cases remained unknown. Approximately half of the wells (53%) were greater than 10 years old and 33% were over 15 years of age. The ages of 24 wells (11%) were not determined.

As indicated in Appendix D, drilled wells were more common in Areas 1 (80%), 3 (64%), 4 (53%) and 6 (46%). Point wells were numerous only in area 6 (22%), and were absent in area 4. Dug wells were common in Area 1 (69%).

As indicated in Appendix E, 53% of the residents complained of hard water and 52% of excess iron. Seventeen percent complained of taste and 15% of odour. Quantity problems were reported in 37 residences which equaled 17% of the total number surveyed.

Treatment was used in 24% of the homes, 10% of which utilized softeners. Area 3 residences used the highest number of treatment systems, namely 35%, followed by Areas 1, 6, 5, 2 and, finally Area 4 where no treatment at all was reported.

SAMPLE RESULTS

Water Supplies

Results of the bacteriological analysis of drinking water supplies indicated only 10 (5%) samples were contaminated by the total coliform group while only 1 (0.5%) sample contained a fecal coliform count. The presence of total coliforms may indicate soil runoff or less recent sewage pollution. Fecal coliforms originate in the intestinal tract of warm blooded animals and their presence in well water strongly suggests nearby and recent pollution.

Of the 10 samples containing total coliforms, 4 were from drilled wells, 5 were from dug wells and 1 source was unknown.

Therefore, bacteriological contamination was not extensive and the aquifers serving the entire Algonquin area are presently considered to be acceptable from a bacteriological standpoint.

Appendix F summarizes the chemical results of the drinking water samples.

Nitrate levels may affect formula fed infants under three months of age in concentrations greater than 10 mg/L. This level was exceeded in 20% and 19% of the samples in Areas 4 and 5 respectively.

Elevated nitrates were mainly associated with shallow dug wells (7/11 or 64%) in these areas although 2 drilled wells

(18%) and 2 shallow point supplies also contained levels greater than 10 mg/L.

Over the entire Algonquin Road area nitrates were found in 16 wells; 11 (68%) of these wells were dug, 3 (19%) were drilled and 2 (13%) were points.

Approximately 8% of the nitrate samples throughout the entire area exceeded this Ministry's criteria. No excessive levels were observed in areas 2 and 6.

When an analysis of a water supply indicated nitrates exceeding the guidelines, the owner and the Medical Officer of Health were immediately informed by letter of the potential risk to newborn infants, although no cases of nitrate induced methemoglobinemia have been reported in the Sudbury area. Nitrates present no risks to consumers over 3 months of age.

Sodium, a constituent of common salt, may aggravate hypertension and complicate heart disease, and people placed on salt-free diets should limit their consumption of it. Although no official criteria exists, the M.O.E. has adopted the interim procedure of notifying the Medical Officer of Health of any water supplies with sodium in excess of 20 mg/L.

Water softening equipment used by many households exchanges sodium for the objectionable calcium salts and removes the hardness associated with these salts. Since water samples were collected after such equipment, homes with softeners were not considered to represent actual groundwater conditions. Omitting these, 34% of the groundwater samples exceeded 20 mg/L.

Areas 2 and 3 had the highest percentages of excessive sodium results, 63% and 50% respectively. No samples exceeded the limit in Area 4. A list of the residences with elevated sodium was forwarded to the Medical Officer of Health for evaluation and follow up procedures.

Iron and manganese stain and discolour laundry and plumbing fixtures when present in concentrations greater than 0.3 mg/L and 0.05 mg/L respectively. They are considered a nuisance and are not a health hazard.

Iron and manganese exceeded the criteria in an average of 46% and 65% of the water supplies throughout the entire area, ranging from 33% in area 5 to 54% in area 6 for iron, and 57% in area 1 to 80% in area 4 for manganese.

Colour and turbidity levels (frequently associated with iron and manganese) also affect the appearance of a water supply but do not constitute a health hazard. For the entire area, 48% and 50% of the samples contained colour and turbidity levels exceeding the guidelines respectively. The occurrence of excess levels ranged from 13% in area 4 to 81% in area 2 for colour, and 42% in area 5 to 64% in area 6 for turbidity.

In general, only water supplies in areas 4 and 5 contained a chemical constituent which was of concern, namely nitrates. Overall, the aquifers in areas 1 to 6 contained excessive iron, manganese, colour and turbidity.

Surface Water

Surface water samples were collected in April 1978 in preparation for the summer survey. Spring bacteriological samples taken during high runoff periods were compared to samples collected during the dry summer period.

The results are given in Appendices G and H. Bacteriological results for the July sampling are summarized in Appendix H. Since bacteria counts in the April samples were virtually absent, the data is not presented.

With the exception of one sample, the chemical analyses of four stream samples and eleven ditch samples were not indicative of sewage pollution since the biochemical oxygen demand and suspended solids concentrations were very low.

Bacteriological results of the 32 surface water samples taken in July reflected the numerous direct discharges of laundry wastes and were uniform throughout areas 1 to 6.

The sampling locations for both the chemical and bacteriological results are mapped in Appendix J.

CONCLUSIONS

The groundwater aquifers presently providing sources of water supply for the residents of the Algonquin Road area are highly coloured and turbid, and contain excessive iron and manganese. Such water can be considered aesthetically displeasing but because of the absence of widespread bacteriological and chemical health hazards, the groundwater condition can only be classified as a nuisance.

Nitrate levels were observed in subareas 4 and 5 in numbers high enough to be of concern although excessive levels were largely restricted to shallow dug wells.

Surface water quality was indicative of bacteriological contamination associated with laundry wastes which could be improved by the elimination of the numerous grey water discharges.

All the sewage system problems observed during the survey can be rectified on an individual basis and do not represent a serious health or environmental problem.

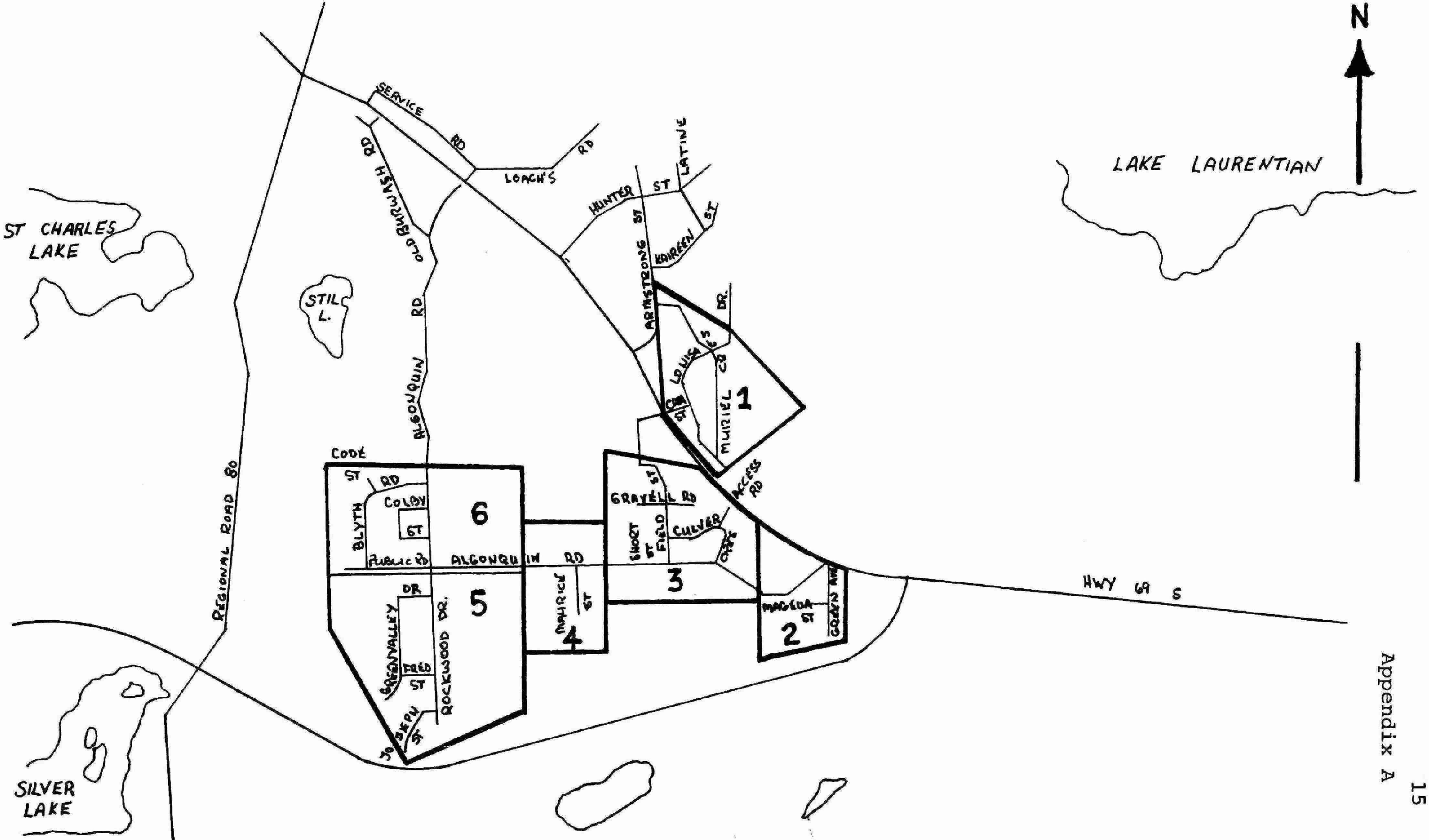
Water shortages were not reported as a serious problem by the residents of the Algonquin Road area.

RECOMMENDATIONS

Based on the levels of nitrates found in the groundwater in subareas 4 and 5, a communal water service should be considered for these streets.

Although nuisance levels of iron, manganese, colour and turbidity were found throughout the Algonquin Road area, communal services are not required for the remainder of the study area for health reasons; but they might be considered, when it is economically feasible, to upgrade the aesthetic quality of water supplied to the residents.

Algonquin Road Survey 1978
Subareas



Appendix A

SURVEY FORM

Algonquin Road Survey
1978

COMMUNITY: ____________________

INFORMATION RECEIVED FROM: ____________________

SURVEYED BY: ____________________

SAMPLE INFORMATION

Type	Bacteriological				Chemical
Sample No.					
Sample Location					
Results	Total	Faecal	Total	Faecal	

PROPERTY INFORMATION

Name of Owner ____________________ Owner's Phone No. __________

Permanent Address ____________________

Name of Resident ____________________

Lot No.	Conc.No.	Township	Community	Street Address	Phone No.

Size of Lot	Drainage	Topography	Soil Type

No. of Residents	No. of Bedrooms	Laundry Facilities	Other

SEWAGE DISPOSAL SYSTEM

Type	Septic Tank ______ Tile Bed ______ (enter distances)	Leaching Pit	Pit Privy	Other (Specify)

Age	Distance to Surface Water	Distance to Water Supply	

Comments: ____________________

Note Quantity

WATER SUPPLY

Type	Surface Water	Dug Well	Drilled Well	Cased Well	Point

Depth	Age	Type & Capacity of Pressure System	Type of Pipe	Chlorinator	Filtration

Comments:	Taste	Odour	Colour	Iron	Hardness	Quantity	Quality	

DIAGRAM ON REVERSE SIDE SHOWING LOCATION AND DISTANCES FOR WATER SUPPLY AND SEWAGE DISPOSAL

SEWAGE SYSTEMS INFORMATION

TYPE	AREA #1		#2		#3		#4		#5		#6		Total Area	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Septic tank and tile field	43	96	16	100	47	94	14	93	43	100	49	100	212	98
Leaching pit	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Pit privy	0	0	0	0	2	4	0	0	0	0	0	0	2	1
Holding tank	0	0	0	0	1	2	1	7	0	0	0	0	2	1
Proprietary system	1	2	0	0	0	0	0	0	0	0	0	0	1	.05
Sewage disposal problems	3	6	0	0	3	6	2	23	2	5	1	2	11	5
Grey water discharges	11	26	6	37	12	24	2	13	7	16	3	6	41	19
Age in years														
0 - 5	7	16	2	12	6	12	4	27	13	30	4	8	36	17
6 - 10	15	34	6	36	15	30	7	47	9	21	15	30	67	30
11 - 15	9	21	1	6	6	12	1	7	10	23	14	28	41	19
> - 15	13	29	2	12	18	36	2	12	11	26	11	22	57	26
Unknown	0	0	5	32	5	10	1	7	0	0	6	12	17	8

TYPES AND AGES OF WELLS

TYPE	AREA													
	#1		#2		#3		#4		#5		#6		Total Area	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Dug	4	9	11	69	16	32	7	47	20	47	13	26	71	33
Drilled	35	80	5	31	32	64	8	53	16	37	23	46	19	55
Point	4	9	0	0	2	4	0	0	7	16	11	22	24	11
Unknown	1	2	0	0	0	0	0	0	0	0	2	6	3	1
Age in years														
0 - 5	7	16	1	6	6	12	3	20	12	28	7	14	36	17
6 - 10	12	27	6	38	13	26	6	40	6	14	12	24	55	25
11 - 15	8	18	3	19	4	8	1	7	9	21	14	28	39	18
> - 15	16	37	2	12	17	34	3	20	15	35	11	22	64	29
Unknown	1	2	4	25	10	20	2	13	1	22	6	12	24	11

Appendix D

SUMMARY OF CONSUMER WELL COMPLAINTS

	AREA #1		#2		#3		#4		#5		#6		Total Area	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Taste	5	11	6	37	9	18	0	0	5	12	13	26	38	17
Odour	4	9	4	25	7	14	0	0	1	2	16	33	32	15
Colour	3	7	3	19	7	14	0	0	1	2	9	18	23	11
Hardness	24	53	10	62	26	52	6	40	18	42	32	65	116	53
Iron	23	51	9	56	25	50	2	13	19	44	35	71	113	52
Quantity	11	24	5	31	6	12	1	7	10	23	9	18	42	19

WATER TREATMENT UTILIZED

Filters	8	19	0	0	10	21	0	0	4	9	8	16	30	14
Softeners	5	14	2	13	7	15	0	0	4	9	4	8	21	10

Appendix E

SAMPLE RESULTS EXCEEDING M.O.E. GUIDELINES

	AREA #1		#2		#3		#4		#5		#6		Total Area	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Iron	21	48	8	50	19	37	5	33	19	44	27	54	99	46
Chloride	1	2	0	0	10	19	0	0	0	0	0	0	11	5
Colour	19	43	13	81	26	54	2	13	17	40	27	54	104	38
Turbidity	21	48	9	56	25	48	8	53	18	42	32	64	113	52
Sodium*	18	41	11	69	29	56	4	27	17	40	15	30	94	44
Sulphate	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nitrate	1	2	0	0	4	8	3	20	8	19	0	0	16	8
Manganese	25	57	11	69	34	65	12	80	29	67	29	58	140	65

Ministry of the Environment Standards for Chemical Parameters

Parameter	Concentration
Nitrate	10 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Colour	5 Hazen Units
Turbidity	1.0 Formazen Units
Sulphate	250 mg/L
Chloride	250 mg/L

* Sodium: 20 mg/L (interim guideline).

Appendix F

SURFACE WATER CHEMICAL QUALITY

JULY, 1978

	BOD	Suspended Solids	Free Ammonia	Total Kjeldahl	Nitrite	Nitrate	Total Phosphorus	Dissolved Reactive Phosphorus	Chloride	Colour	Turbidity	Sodium	Potassium
Stream across 2801 Racewood Drive	0.4	< 5	.1	.1	<.01	<.1	.02	<.02	8	<5	1.2	4	0.9
Stream across 2814 Algonquin Road	0.6	< 5	.1	.4	.01	.3	.04	<.02	43	30	4.3	21	1.9
Ditch Algonquin & Field St.	0.8	< 5	.2	.4	.01	.2	.08	<.02	8	5	3.8	5	1.5
Ditch West Side Green St. Across 2650	40	266	6.5	E	.27	1.6	2.6	2.1	217	75	63	240	10.4
Stream Culver St. and Access Road	0.8	< 5	<.1	.4	.01	.5	.04	<.02	40	15	2.5	22	1.6
Ditch Field near Gravelle	0.2	< 5	<.1	.4	.01	.3	.04	<.02	37	15	2.2	20	1.5
Ditch South Side Cam & Louisa Street	0.6	< 5	.1	.4	.01	4.1	.04	<.02	198	20	3.7	102	3.2
Ditch Across 2348 Louisa St.	0.6	< 5	.1	.4	.01	1.5	.04	<.02	60	15	2.8	31	2.0
Ditch Blythe & Algonquin Rd.	0.4	.5	.2	.4	.01	.9	.10	<.02	E	< 5	3.2	E	E
Ditch Blythe St. & Public Rd.	0.8	< 5	.4	.8	.03	4.5	.06	<.02	166	5	3.3	37	5.5
Stream South Side Public & Rockwood	0.4	< 5	<.1	.4	.01	.2	.04	<.02	36	20	3.2	21	1.5
Stream Public Rd. & Blyth St.	0.6	< 5	<.1	.4	.01	.2	.04	<.02	35	20	3.3	20	1.5
Ditch Greenvalley Drive Across 2662	1.4	15	.9	1.6	.04	4.1	.12	<.02	80	70	12	41	3.7
Ditch Greenvalley & Fred St.	0.6	5	.2	.2	.01	.3	.04	<.02	17	< 5	4.5	8	1.4
Ditch North Side Public & Rockwood Drive	1.0	< 5	.1	.6	.01	.8	.06	<.02	55	30	3.6	23	2.3

E means that this parameter was not measured.

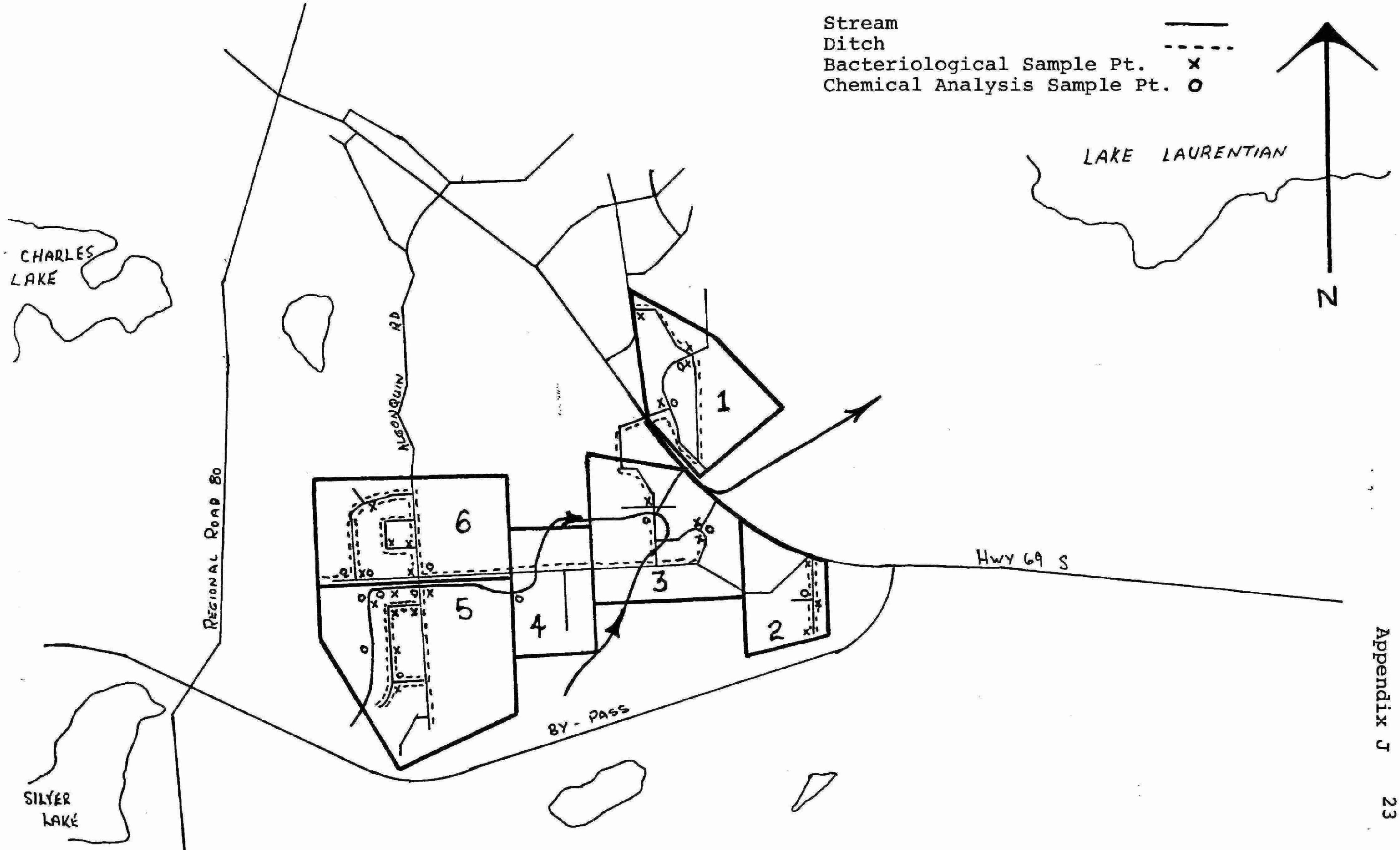
All results are in mg/L except colour (Hazen Units) and turbidity (Formazin Units).

SURFACE WATER BACTERIOLOGICAL QUALITY

JULY 1978

Location	Total Coliforms per 100 ml	Faecal Coliforms per 100 ml
Blythe & Algonquin	>8000	>1200
Public & Rockwood	>8000	860
2662 Green Valley	>8000	>1200
Green Valley & Rockwood	>8000	>1200
2650 Green	>8000	>1200
Culver & Access	>8000	>1200
Field Street	1220	680
Cam & Louis	>8000	>1200
2348 Louis	1200	<40
Louis & Muriel	>8000	>1200
Algonquin & Rockwood	>8000	>1200
Green & Algonquin	>8000	>1200
2401 Blyth	>8000	>1200
2784 Green Valley	>8000	>1200
2701 Green	>8000	>1200
Armstrong & Muriel	>8000	>1200
Colby & Algonquin	>8000	>1200
Field St. Stream	7600	560
Gravelle St. Stream	820	60
Culver St. Stream	>8000	560
Muriel End	>8000	>1200
Muriel Middle	>8000	>1200
Middle of Colby	>8000	>1200
Stream on Public	1000	40
Stream on Public	220	4
Stream on Public	1600	20

Algonquin Road Survey 1978
Surface Water Sampling Locations
July 1978



Appendix J

APPENDIX K

GLOSSARY

A. BACTERIOLOGICAL EXAMINATIONS

1. Coliform Bacteria

The direct search for a specific pathogen in water is too uneconomical and slow for routine control purposes. Instead water is examined for an indication of fecal contamination by using specific groups of bacteria as indicators. When these groups are found in the water it is assumed that the water is potentially harmful. The standard group of micro-organisms used as an indicator is the coliform group which includes all aerobic and facultative anaerobic, Gram-negative, nonspore forming, rod-shoped bacteria that ferment lactose with gas formation within 48 hours at 35°C. Organisms of the Escherchia coli strains which are usually of fecal origin, and of the intermediate and Aerobacter aerogenes strains which are usually but not always of soil, vegetable, or other non-fecal origin are included in this group.

1 (a) Total Coliforms

This group comprises species that are commonly associated with fecal matter (human and animal) and normal inhabitants of soil and vegetation. The presence of total coliforms in water may indicate contamination from soil runoff, or, less recent fecal pollution.

1 (b) Fecal Coliforms

These bacteria are mainly species associated with human and animal fecal matter. The presence of fecal coliforms in water indicates a relatively recent and near pollution input.

B. CHEMICAL ANALYSES

1. Alkalinity

Alkalinity is the measure of the power of a solution to neutralize hydrogen ions. It is used to define the buffering capacity (the capacity to resist changes in pH) of water. Alkalinity is expressed in terms of an equivalent amount of calcium carbonate. This does not necessarily imply that there is this much calcium carbonate in the water or that there is any at all. The alkalinity measurement represents the quantity of acid, expressed as calcium carbonate, needed to reduce the pH of a measured portion of sample 4.5. It is caused by the presence of carbonates, bicarbonates, and hydroxides, and to a lesser extent by the presence of borates, silicates, phosphates, and organic substances. Alkalinity is not considered detrimental to human health but it is generally associated with high pH values, hardness and excessive dissolved solids.

2. Colour - Apparent

Apparent colour includes colour due to dissolved solids and suspended matter. Surface water colour is due mostly to the presence of humic acids derived from decomposition of plant material. In groundwaters colour is usually due to the presence of iron and manganese. Most naturally coloured water (usually yellowish-brown) is harmless. The objective for domestic water supplies in Ontario is 5 Hazen Units.

3. Chloride

Chloride concentrations in water supplies may result from contact with natural minerals, industrial and agricultural wastes, or human and animal sewage. Urban runoff often contains high concentrations of chloride in the winter due to the application of road salt. Chlorides are generally not harmful. Allowable concentrations in drinking water are based on palatibility requirements rather than on health considerations. The water quality objective for domestic drinking water supplies in Ontario is 250 mg/L.

4. Conductivity

Conductivity is defined as the reciprocal of a water's electrical resistence (in ohms) between two electrodes one square centimeter in area and one centimeter apart at a standard temperature at 25°C. It is a measure of the ion concentration in water. In natural waters conductivity is mainly due to calcium, magnesium, sodium, potassium, bicarbonate, chloride, sulfate, and nitrate ions. Conductivity can be correlated with dissolved solids content. In Ontario the dissolved solids content is equal to 0.65 ± 0.10 times the conductivity. The permitted level for conductivity in drinking water in Ontario is indirectly established by the limit for dissolved solids.

5. Hardness

Hardness, defined as the soap neutralizing power of water, can be expressed in terms of an equivalent concentration of calcium carbonate. Hardness is mainly attributable to the presence of calcium and magnesium ions resulting from the natural accumulation of salts during contact with soil and geological formations. Hardness is objectionable because it reduces the efficiency of soap and it can produce scums and scales. Hardness in drinking water is limited indirectly by the criteria for dissolved solids (maximum of 500 mg/L). Concentrations over 120 mg/L become increasingly inconvenient.

6. Iron

Iron is the most abundant of the heavy metals in nature but despite this abundance it is generally found in relatively low concentrations in natural surface waters. In groundwater, however, conditions may be such that high concentrations of iron remain in solution. Iron concentrations occur in water due to the leaching of soluble iron salts from soil and rocks. Iron is non-toxic even at high concentrations but becomes objectionable in water because of the taste and odour it imparts. It also tends to precipitate as hydroxides staining laundry and porcelain fixtures. Also, ferric iron combines with the tannin in tea to produce a dark violet colour. The water quality objective for drinking water in Ontario (0.3 mg/L) is based on aesthetic and taste considerations.

7. Manganese

Manganese is a common element in nature and found in numerous minerals which include pyrolusite, braunite, manganesespat. It is essential in trace quantities for the proper nutrition of both plants and animals. Although manganese is non-toxic at levels commonly encountered in water supplies, it can cause unpleasant tastes and stain laundry and plumbing fixtures. Iron and manganese are commonly found together.

8. Nitrate Nitrogen

Nitrates are the end products of the aerobic stabilization of organic nitrogen and as such they occur in polluted waters that have undergone self-purification. They can occur in groundwater as a result of leachings from cesspools or fertilized soil. Photosynthetic action is constantly utilizing nitrates and converting them to organic nitrogen in plant cells but in groundwater this action is not possible and high concentrations of nitrates can result. Nitrates are undesirable because their nutritive properties promote the growth of algae and other aquatic plants. Although nitrates are considered non-toxic to adults, high levels in domestic water supplies can lead to a condition known as infant methemoglobinemia in which the oxygen carrying capacity of the blood is inhibited. The maximum acceptable level of nitrates for domestic water supplies in Ontario is 10 mg/L if the water is to be used for infant feeding.

9. pH

The symbol pH is used to designate the logarithm (base 10) of the reciprocal of the hydrogen ion activity. In the case of natural waters the hydrogen ion activity closely approximates the hydrogen ion concentrations in moles per litre. Although the hydrogen ion is a potential pollutant in itself, pH is also intimately related to the concentrations of many other substances. The degree of dissociation of many substances is influenced by pH and since the undissociated compounds are frequently more toxic than the ionic forms pH may be a highly significant factor in determining limiting concentrations. Also the hydrogen ion concentrations is important because it affects the taste and corrosivity of water and the efficiency of chlorination.

10. Sodium

Sodium ranks sixth in the natural order of elemental abundance and is normally the principal ion in brackish or saline groundwater. It is important for all life forms and is generally considered non-toxic. Patients with high blood pressure however are usually warned to avoid the consumption of water containing high concentrations of sodium. Waters softened by the ion-exchange process employed in most domestic water softening equipment, generally contain high levels of sodium.

11. Sulfates

Sulfates occur naturally in water as a result of leachings from minerals. Sulfates may also occur as the final oxidized stage of sulfides, sulfites, and thiosulfates, as the oxidized state of organic matter in the sulfur cycle and as a result of industrial wastes. Water high in sulfates tends to form hard scales on plumbing and increase the corrosiveness of water towards concrete. Under anoxic conditions sulfates serves as an oxygen source for bacteria which convert it to hydrogen sulfide gas. The maximum sulfate concentrations permissible for domestic water supplies in Ontario is 250 mg/L. Although the limit is not based on taste or physiological considerations, concentrations over the limist may exert a cathartic effect on the gastro-intestinal tract.

12. Turbidity

Turbidity is a measure of the optical properties of a water sample. It is attributable to suspended and colloidal matter which diminishes the penetration of light. Turbidity is useful in assessing water clarity. In Ontario turbidity is measured in Formazin Units.

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